

providing a reactor with a reaction chamber having a first volume;
contacting a surface of a substrate in the reaction chamber with a first precursor at the first chamber volume to react with and deposit a first layer on the substrate; and
enlarging the reaction chamber to a second, larger volume and removing undeposited first precursor and any excess reaction product to end reaction of the first precursor with the substrate.

[c2]

2. The method of claim 1 further including:
reducing the reaction chamber to the first chamber volume;
contacting the first layer in the reaction chamber with a second precursor at the first chamber volume to react with and deposit a second layer on the first layer, thereby forming a film; and
enlarging the reaction chamber to the second volume and removing undeposited second precursor and any excess reaction product to end reaction of the second precursor.

[c3]

3. The method of claim 1 wherein removing undeposited first precursor and any excess reaction product is by purging the reaction chamber at the second volume with a gas.

[c4]

4. The method of claim 1 wherein removing undeposited first precursor and any excess reaction product is by exposing the reaction chamber at the second volume to a vacuum.

[c5]

5. The method of claim 1 wherein the reaction chamber includes a pedestal adapted to secure the substrate during the deposition and movable between first and second positions, a first chamber section above the pedestal in the first position defining the first chamber volume, and a second chamber section outside the first chamber section; and wherein the reaction chamber is enlarged to the second, larger volume by moving the pedestal to the second position such that the first and second chamber sections together with the pedestal in the second position define the second chamber volume.

[c6]

6. The method of claim 1 wherein the second chamber section is on one or more sides of the pedestal.

[c7]

7. The method of claim 1 wherein the second chamber section is below the pedestal.

[c8]

8. A method of depositing a film on a substrate comprising:

providing a reactor with a reaction chamber having a first volume;

contacting a surface of a substrate in the reaction chamber with a first precursor at the first chamber volume to react with and deposit a first layer on the substrate;

enlarging the reaction chamber to a second, larger volume and removing undeposited first precursor and any excess reaction product to end reaction of the first precursor with the substrate;

reducing the reaction chamber to the first chamber volume;

contacting the first layer in the reaction chamber with a second precursor at the first chamber volume to react with and deposit a second layer on the first layer, thereby forming a film; and

enlarging the reaction chamber to the second volume and removing undeposited second precursor and any excess reaction product to end reaction of the second precursor.

[c9]

9. The method of claim 8 wherein the reaction chamber includes a pedestal adapted to secure the substrate during the deposition and movable between first and second positions, a first chamber section above the pedestal in the first position defining the first chamber volume, and a second chamber section outside the first chamber section; and wherein the reaction chamber is enlarged to the second, larger volume by moving the pedestal to the second position such that the first and second chamber sections together with the pedestal in the second position define the second chamber volume.

[c10]

10. The method of claim 1 wherein the second chamber section is on the side of and below the pedestal.

[c11]

11. An apparatus for depositing a film on a substrate comprising:

a reactor having a variable volume reaction chamber for reacting one or more precursors with the substrate to deposit a film thereon;

a pedestal in the reaction chamber adapted to secure the substrate during the deposition, the pedestal being movable between first and second positions;

a first chamber section above the pedestal in the first position;

a second chamber section outside the first chamber section,

wherein volume of the reaction chamber may be varied by moving the pedestal between the first position, where the first chamber section together with the pedestal in the first position define a first chamber volume, and the second position, where the first and second chamber sections together with the pedestal in the second position define a second, larger chamber volume.

[c12]

12. The apparatus of claim 11 wherein the pedestal is movable upwards to the first position and downwards to the second position.

[c13]

13. The apparatus of claim 11 wherein the second chamber section is on one or more sides of the pedestal.

[c14]

14. The apparatus of claim 11 wherein the second chamber section is below the pedestal.

[c15]

15. The apparatus of claim 11 further including a perforated plate above the pedestal in the first chamber section, the perforated plate being adapted to diffuse the precursors.

[c16]

16. The apparatus of claim 11 further including an environmental control for maintaining the first chamber section at a different temperature than the second chamber section.

[c17]

17. An apparatus for depositing a film on a substrate comprising:

a reactor having a variable volume reaction chamber for reacting one or more precursors with the substrate to deposit a film thereon;